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# LIFE HISTORY AND COLD STORAGE OF *AMBLYSEIUS CUCUMERIS* (ACARINA:PHYTOSEIIDAE)

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## Abstract

Details were determined for the life history of the phytoseiid mite, *Amblyseius cucumeris,* with first-instar western flower thrips, *Frankliniella occidentalis,* as prey. *A. cucumeris* completed development in 11.09, 8.74 and 6.25 days at 20, 25 and 30°C respectively. This is slightly longer than reported for *A. cucumeris* by other authors using eggs of *Tetranychus* mites as prey. The mean egg production was 1.5 ± 0.99 eggs per day. In cold storage tests, after 10 weeks, 63% of *A. cucumeris* survived at 9°C, 1.2% survived at 2°C and 0% survived at -8°C.

## INTRODUCTION

The predatory mite, *Amblyseius cucumeris* Oudemans (Acarina:Phytoseiidae), is a potential biological agent for various species of thrips (Thysanoptera) on greenhouse cucumbers and peppers (Ramakers 1983; De Klerk & Ramakers 1986). Previous work on the biology and life history of *A. cucumeris* was done using eggs of various tetranychid mite species (eg. El-Badry & Zaher, 1961, Kolodochka 1985). This did not allow for possibly different effects of an insect host on predator performance, and since thrips appear to be the primary prey of *A. cucumeris* it was advisable to study its biology on those prey. In addition previous studies have not addressed the effects of temperature on life history. Since temperature can have a dramatic impact on the duration of life stages, the performance of *A. cucumeris* under a range of temperatures typical for greenhouse vegetable culture should be evaluated.

*A. cucumeris* can be mass reared on grain mites, *Acarus* spp. (Acarina:Acaridae) in bran in numbers approaching $10^5$ per litre of bran (Ramakers & van Lieburg, 1982). The ability to raise a biological control agent in such large numbers makes long term storage of colonies feasible.

Here we report details of the life history of *A. cucumeris* at various temperatures with *Frankliniella occidentalis* (Thysanoptera:Thripidae) as prey, as well as results of cold storage experiments with *A. cucumeris*.

## MATERIALS AND METHODS

*Amblyseius cucumeris*, originally obtained from Koppert B.V. in Holland, were reared as described by Ramakers & van Lieburg (1982), in bran with the grain mite, *Acarus siro* L., and a mold mite, *Tyrophagus* sp. as hosts. Fresh *A. cucumeris* eggs were collected from cultures by placing a 2 cm x 2 cm square of black felt in the rearing containers. Eggs deposited on the felt during a 6 h were collected and placed individually on 1 cm diameter disks of bean leaf on a pad of absorbent cotton saturated with water in a petri dish. These were placed in incubators at 20, 25, 30 or 35°C. First-instar *Frankliniella occidentalis* (3-5) were provided daily as food. Mites were observed daily for the presence of cast skins, indicating a molt, until they reached the adult stage.

Oviposition was observed for 10 days in eight freshly mated *A. cucumeris* females which were approximately 24 h old at mating. These were placed individually on 2 cm diameter leaf disks at 20°C as described above and provided daily with fresh thrips nymphs. The eggs were counted and removed daily.

To test cold storage, a 1.5 ml sample of bran from a culture containing 25 mites/ml was transferred from a source culture into a 50 ml plastic snap cap vial. Lids with 1 cm holes drilled in them placed over disks of paper towel over the vials allowed for ventilation. Seven vials were placed in each of 12 plastic bags. A wet paper towel was placed in each bag to maintain humidity, and bags were sealed with sponge stoppers held in place with twist ties. Three bags were placed at 9°C, and six at 2°C. After one week three bags were moved from 2°C to -8°C. The vials in the three remaining bags were processed immediately as described below, for controls.

One vial was removed from each bag at two week intervals. Vials and contents were allowed to return to room temperature for at least two hours. Vial contents were flushed through 50 and 200 mesh sieves with running tap water. The contents of the 200 mesh sieve were washed with water into a counting dish and the number of living and dead mites were counted under a stereomicroscope. The percentage survival was calculated as [Number alive/(number alive + number dead)] x 100.

After counting each sample, ten living mites were individually transferred from the counting dish to leaf cages on a bean leaf and supplied with thrips nymphs for food. These were maintained until *A. cucumeris* eggs were observed.

## RESULTS AND DISCUSSION

The average time for development of *A. cucumeris* from egg to adult decreased from 11.1 days at 20°C to 6.3 days at 30°C (Table 1). The time spent in each life stage decreased as temperature increased from 20°C to 30°C. At 35°C the eggs hatched in less than 2 days but the larvae died within 24 h and none moulted to protonymph.

Table 1. Development time of *Amblyseius cucumeris* (mean ± standard deviation (n)) fed on *Frankliniella occidentalis* nymphs at 3 temperatures.

| Temp (C) | Egg | Larva | Protonymph | Deutonymph | Total Time |
|---|---|---|---|---|---|
| 20 | 2.94±0.77 (30) | 1.38±0.52 (8) | 3.17±0.38 (18) | 3.60±0.84 (10) | 11.1 |
| 25 | 3.11±0.71 (30) | 1.15±0.38 (13) | 2.42±0.72 (24) | 2.06±0.43 (17) | 8.7 |
| 30 | 1.89±0.27 (30) | 0.36±0.50 (11) | 2.00±0.82 (21) | 2.00±0.82 (13) | 6.3 |

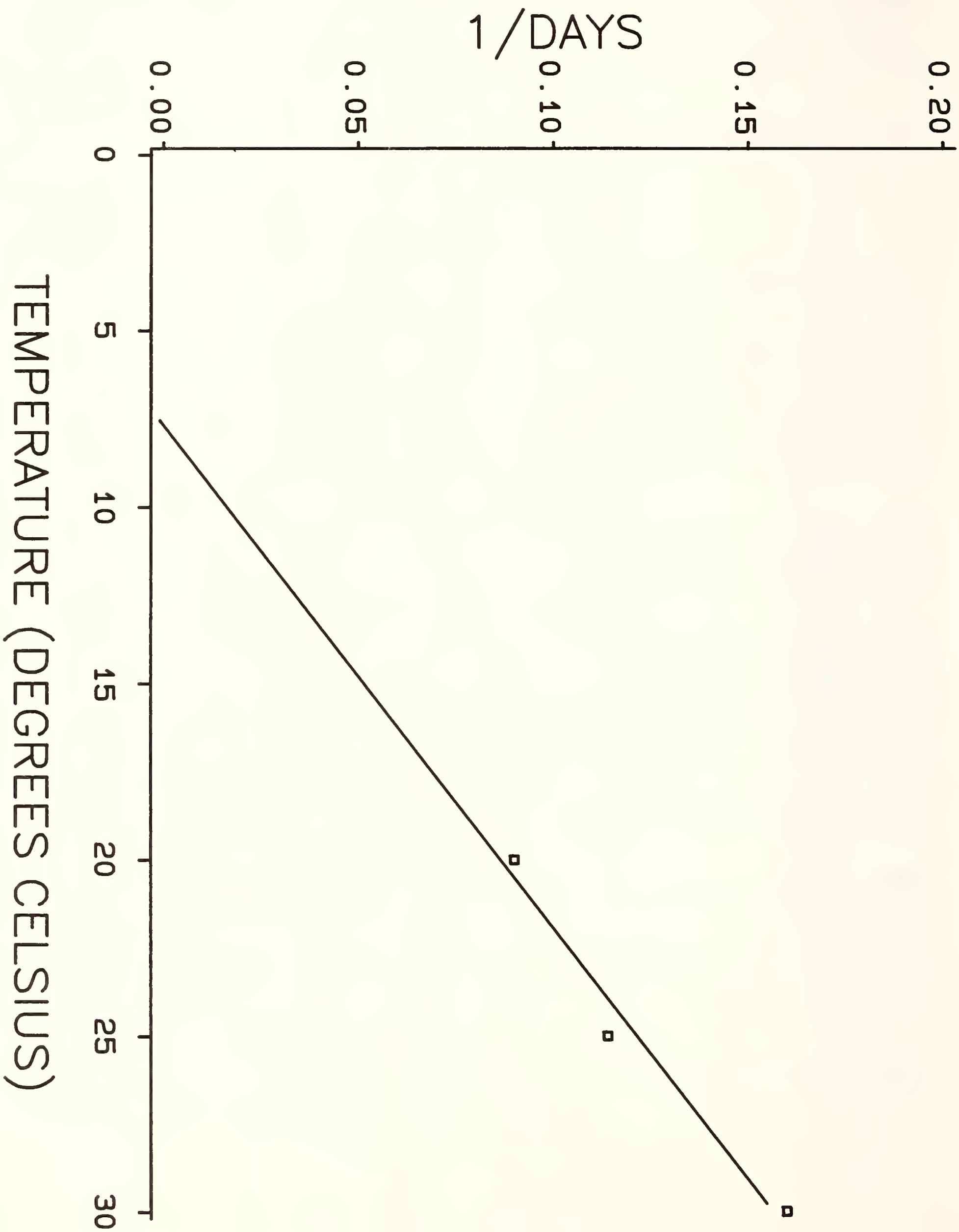


Figure 1. Regression of inverse of developmental time for *A. cucumeris* vs temperature of rearing. Equation of line: y = -0.0537 + 0.007 x (r = 0.97).

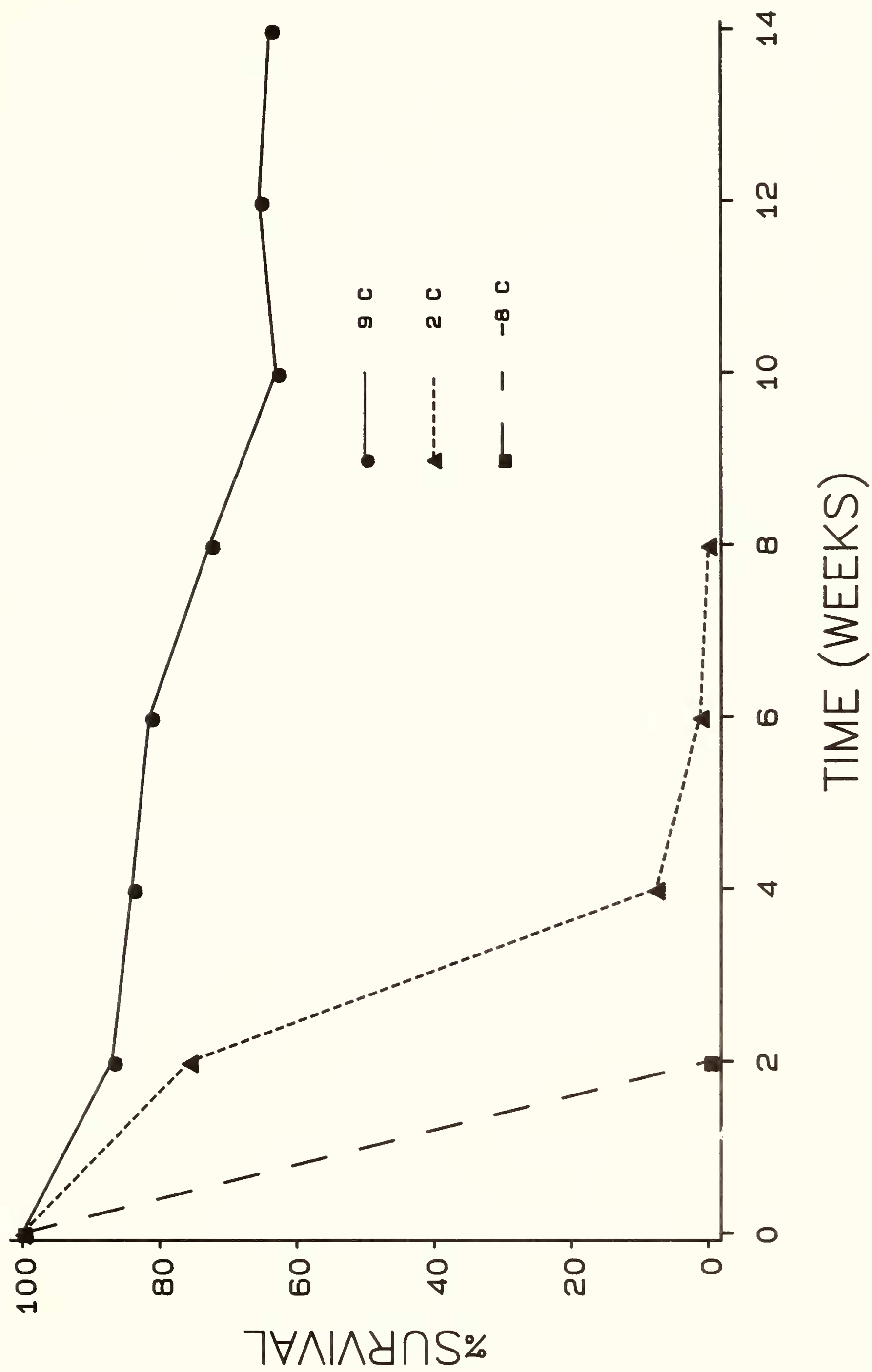


Figure 2. Percent survival of *Amblyseius cucumeris* stored in bran at 9, 2 and -8°C.

El-Badry and Zaher (1961) found a development time of 0.7 days (larva), 1.5 days (protonymph) and 1.4 days (deutonymph) for *A. cucumeris* reared on eggs of *Tetranychus cinnibarinus* eggs at 29°C. Kolodochka (1985) reported a development time of 6.25 days and 6.29 days for *A. cucumeris* males and females, respectively, reared on *Tetranychus* sp. eggs at 26°C. In both cases, the development times were somewhat shorter than those reported here. This may be due to the somewhat greater amount of energy required to capture and kill a thrips larva than that for a *Tetranychus* egg. *F. occidentalis* larvae were observed defending themselves against *A. cucumeris* in the same manner described for *Thrips tabaci* by Bakker and Sabelis (1986).

The threshold temperature for development, as determined by regressing the inverse of development time against temperature and extrapolating (Figure 1), is 7.7°C. This indicates that *A. cucumeris* is able to reproduce and develop across the range of normal greenhouse temperatures, and suggests that it may even be useful in temperate climates in field crop situations where thrips are pests.

Copulation was observed in eight pairs of *A. cucumeris*. The time from copulation until eggs were laid was 3.2 ± 0.83 days. The number of eggs laid by each female per day ranged from 0 to six with two being the most common. The mean egg production for the eight mites was 1.5 ± 0.99 eggs per female per day. This is comparable to an egg production of 1.6 per female per day for *A. cucumeris* eggs (El-Badry & Zaher 1961). It was not possible to observe oviposition over the life span of the females because most of them became entangled in the water-soaked cotton pads in the petri dishes and drowned.

In cold storage at 9°C, *A. cucumeris* survival decreased from 86.9% after 2 weeks to 63% after 10 weeks (Figure 2). At 2°C, a maximum-minimum thermometer placed in the refrigerator showed that the temperature decreased to -2°C on several occasions between the second and sixth week. At -8°C survival was 0% after 2 weeks when sampling was discontinued. All mites that survived cold storage were observed feeding within 24 hours of rewarming, and eggs were produced within 3 days. These results indicate that *A. cucumeris* cannot survive temperatures of less than 0°C. However, long-term storage of several weeks is possible at 9°C with relatively little mortality.

In summary, *A. cucumeris* will feed, develop and reproduce on *F. occidentalis*. It requires slightly longer to complete development with *F. occidentalis* nymphs as prey than with *Tetranychus* eggs. The ability to feed on alternate hosts, particularly mite eggs and pollen suggest that it could survive in a greenhouse in the absence of thrips as noted by De Klerk and Ramakers (1986). The ability of *A. cucumeris* to survive cold storage at 9°C for up to 14 weeks will facilitate mass production and transportation of this useful predator.

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